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(UGC recognized, NAAC Re-accreted 'B'grade state university)

Studies on Management of Early Blight of Potato caused by *Alternaria solani* (E. & M.) through selected Fungicides, Plants extracts and Biological agents

Pre synopsis submitted

for the confirmation of Ph. D. topic

In the subject

(Botany)

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Introduction: -

Potato (*Solanum tuberosum L.*) is a recognized vegetable in India and abroad.

Potato is the most important food crops growing in India after cereals. (Miyu et al..,2019).

It is an herbaceous dicotyledon plant belonging to the family solanaceae, it is used as a food due to content of minerals vitamins micronutrients anti-oxidants etc. Potato is an important food crop, it contains high protein calories, more edible energy, rich in carbohydrates, quality protein, dietary fibbers as a balanced nutritive food. Quality of potato proteins is comparable to egg and milk. Therefore, it is superior to those present in cereals pulses and vegetables for the high population areas like India. It is an important supplement food. It is also an important in cotton industries for sizing the clothes as well as paper industries, production of alcohol, adhesives etc. The soil and seed-borne diseases influence the crop stand by inhibiting the development of potato sprouts and cause severe rots in tubers.

Potato (*Solanum tuberosum L.*) ranks first as a non-cereal food crop for human consumption and has a great potential in ensuring food security in developing nations (FAOSTAT 2019). The diverse distribution pattern and major cultivation as a cash crop in areas having a high level of hunger and malnutrition make it a global crop in sustainable food availability (Haverkort et al. 2013; Devaux et al. 2020; Lal et al. 2020a). The food and agriculture organization (FA0) declared the year 2008 as the international year of the potato. Presently, potato is grown over 19 million hectares area with an annual production of 388 million tons worldwide (FAOSTAT 2019). Around 1.3 billion people consume fresh potatoes as a staple food (50 kg per person annually) in India and China. The consistent increase in potato production in the developing world exceeding developed nations indicates its importance as a

source of food, income and employment especially in Asia, Africa and Latin America (Devaux et al. 2020).

Potato is cultivated in India due to its high yield ability. Potato luxuriantly grown in temperate, tropical and sub-tropical regions in India (Marwaha et al.,2010)

Potato is the “kharif” crop and in some region of Marathwada it is cultivated as a “rabbi” crop. Pune and Ahamad Nagar are major potato cultivated district in Maharashtra, it is also cultivated in Marathwada region including Parbhani district.

The tubers are the main part of plant that are directly affected by rot disease. The pattern of shrinking and shrivelling along with lesion development on the outer surface of tubers is common. Simultaneously, the black or brown rot occurs in the internal tissues. The wounds act as the main entry point for the pathogen from where they cause the rotting of the internal tissue giving black, brick orange, whitish or brownish tissue. The tubers showing typical symptoms of dry rot collected from different states of India. The indirect effect of infection can be observed as necrotic lesions on the damaged primary and secondary roots of the potato plant. The first ever study on potato dry rot by Martius in 1842 revealed that the disease is caused by a fungus.

Several novel fungicide molecules (Azoxystrobin, chlorothalonil and fludioxonil), are found very effective as tuber treatment chemicals. Besides, many beneficial bioagents and safer chemicals have shown antibiosis and mycoparasite is against this pathogen. Germplasm screening for rot resistance is important to assist the resistance breeding program for the development of resistant cultivars.

Poor crop and post-harvest management, field and storage diseases, frost and heavy rains are some of the most important factors for yield loss and nutritional profile deterioration in potato (Delgado et al. 2017; Lal et al. 2020b; Tiwari et al. 2020a). There are more than 40 pathogens, such as viruses, fungus, nematode, insects and bacteria which cause damage to foliar parts and tubers in potato (Fiers et

al. 2012; Kumar et al. 2019, 2020). These pathogens agents cause up to 22% direct or indirect losses in the potato production.

The disease has been named as early blight by Jones (1892) since it was observed to develop earlier than Phytophthora blight in the U.S.A. It has also named "Leaf spot" (Mc Alpin, 1911) and Alternaria blight (Heald, 1933). But the name "early blight" becomes popular in the usage.

The disease was first recorded In India by Butler (1903) on potato leaves at Farrukhabad in Uttar Pradesh. It was later observed to be common in Indo-Gangetic plains and Nilgiris (Butler, 1918). The disease is fairly common now and is observed in all the potato-growing regions of the country both in plains as well as in the hills. The different records in India have been reviewed by Butler and Bisby (1960) and Subramanian (1971). The disease was observed in epiphytotic in February 1951 at Jaunpur Uttar Pradesh (Singh and Gupta,1953).

REVIEW OF LITERATURE: -

Early blight of Potato caused by *Alternaria solani* reviewed as follows.

Butler (1903) reported for the first time in India that the *A. solani* caused early blight of potatoes in the Farukabad district of Uttar Pradesh.

Agarwal et al. (1959) explained that the early blight disease was found in all reasons of India. This disease is often associated with tomato and potato production.

Pandey (2014) tested the efficacy of five fungicides at six concentrations, six botanical extracts at three concentrations and five bio-control agents were evaluated under in vitro conditions against *A. solani*. In vitro results revealed that a Mancozeb fungicide was found most effective in reducing the radial growth and sporulation of *A. solani*. Among botanical extracts, Zingiber officinale extract was found best for reducing radial growth and sporulation. Among different biocontrol agents, T. virens significantly reduced the mycelial and sporulation of *A. solani*.

A special report was presented by Spoelder et. al. (2014) demonstrating the pathogenicity of *A. solani* and *A. alternate* is causing early blight in potato. Seven cultivars were taken and infected separately with both the fungi and observed for symptoms of leaf blight. This study suggested that only *A. solani* was able to develop lesions like early blight on leaflets.

Chaerani and Voorrips (2006) wrote a detailed review about *A. solani* and the disease it causes. He said the fungus is the reason behind Early Blight in both potato and tomato foliage. Apart from it causes diseases such as collar rot on seedlings' stems, stem lesions on the stems of adult plants and fruit rot in the fruits of tomato.

Koley et al. (2015) investigated the bio efficacy of six bioagents and twelve botanicals against the early blight of tomato caused by *A. solani* under in vitro conditions. Among six biocontrol agents, B. subtilis showed the maximum inhibition of mycelial growth (52.77%) of pathogen followed by P. fluorescens (47.22%) as compared with other bio agents. Among twelve plant extracts, Datura stramonium was found to be significantly superior followed by Azadirachta indica oil which showed maximum mycelial growth inhibition of 57.03% and 51.35%, respectively at 15% concentration as compared with other treatments.

Aims / Objectives: -

1) To find the association on early blight of potato with the Literature work.

2) Survey and collection of infected parts of plant of Early blight of potato from Marathwada region.

3) To study disease severity of Early blight of potato in Marathwada region.

4) To observe the Isolation, purification and identification of pathogen.

5) To study the Pathogenicity test of Early blight of potato disease.

6) To study in vitro and in vivo growth of *Alternaria solani* (E. & M.) causing Early blight of potato

7) To observe the effect of different fungicides.

8) To study the efficacy of different plant parts Extracts

9) To study the effect of different biocontrol agents.

10) To study the effect of different climatic factors.

Methodology: -

Present investigation will be carried out by using standard methodology and established protocols in the laboratory in following phases.

Phase I: -

literature study will be carried out by online and offline method, by referring different journals, textbooks and manuals etc.

Survey: -

Survey of Early blight of potato will be carried out from Marathwada region. Study will be carried out disease severity by five (5) point scale.

Isolation of Early blight of potato will be carried out by single spore isolation method.

Purification of pathogen will be done by re-culturing young hypal tips.

Identification will be carried out on the basis of morphological characteristics by using literature, book of Alexopolous (1962). Kamat (1961)., Mukadum (1997)., and different keys like Barnett HC (1970) and illustrated genera of fungi imperfecti, Burgess Publication. Minn, U.S.A.

The culture will be sent to the Agarkar research institute, Pune for complete identification and molecular characterisation.

Phase II: -

Pathogenicity test will be confirmed by using simple detached leaf technique method:Maye, C. D. (1983) Epidemiology and Forecasting of Ground nut rust in Marathwada region. Final Report. ICAR project.

Satishkumar L. (1994). Detached leaf bioassay to screen sunflower for Alternaria using the host specific toxin of Alternaria helianthi.

Phase III: -

Effect of fungicides will be studied by food poisoning method: Dhingra, O., & Sinclair, J. (1995). Plant pathology method. In: Boca Raton, FL; CRC Press Inc.

Phase IV: -

Efficacy of plant leaves extract will be carried out by using food poisoning technique/method:D.C Kamthane and B.M Kareppa (2010). Efficacy of calaxin against Altenaria arachidis in vitro.

Phase V: -

Efficacy of different control agents will be observed by dual culture method: A. Bandopadhyay. A. K and N, Samajpatial (2008) In Vitro anti-fungal activity of some bio control fungi against jute pathogen.

Data analysis will be carried out by ANOVA method and different softwars.

Importance of study/society: -

International status: -

Plant diseases have been a significant cause of the worldwide loss of crops. Potato crop is generally affected by different types of biotic and abiotic diseases. Biotic diseases are mainly caused by a detrimental microorganism such as fungi, bacteria (Ashraf et al., 2012) and viruses (Gul et al., 2013), nematodes (Parveen et al., 2013) and mycoplasma which adversely affected the potato quality as well as production in almost all over the world (Nazarov et al., 2020). Different types of abiotic constraints in potato production are nutrient deficiency, salinity, cold and chilling stress (Irshad and Naz, 2014). At the world level, the yield loss in potatoes due to diseases amounts up to 17.2% and ranges from 8.1% to 21% near hotspots (Savary et al., 2019). Globally potato crops are affected by various diseases some destructive

diseases are early blight, late blight, bacterial wilt and leaf roll (Birch et al., 2012; Kreuze et al., 2020) which can cause total yield loss,

Plamadeale et al. (1978) reported that the application of contact-based fungicides like Mancozeb, Captan and Copper oxychloride was found to be most effective against the early blight of potato. These fungicides also created a relationship between disease intensity and yield loss which was highly significant.

The fungicides treated plots showed significantly higher tuber yield compared to untreated plots.

Ona and Van Der Zaag (1988) suggested that some fungicides like Benomyl, Chlorothalonil and Mancozeb were found most effective for suppressing the growth and development of early blight pathogen.

National status: -

The population of India increased day to day and the estimated domestic demand for potatoes is 122 million tonnes by the end of 2050. After independence, India has taken a giant leap in terms of potato area and production. In the year 1949, India used 0.234 million ha area to produce 1.54 million tonnes of potatoes (Scott et al., 2019). Potato is cultivated mostly in all states of India under different agro-climatic conditions. About 85% of potatoes are cultivated in Indo-Gangetic plains of North India. India is the second-largest country after China in the production of potatoes in the world. Indian states such as Uttar Pradesh, West Bengal, Bihar, Punjab, Haryana and Madhya Pradesh major potato growing states. Uttar Pradesh is the state of India leads in terms of area, production and productivity of potatoes. During the current year In India, Uttar Pradesh shares 31.36 % of total potato production followed by West Bengal (23.29%), Bihar (13.22%) and Gujarat (7.43%). In India among various varieties of potato, four varieties of potato such as Kufri Jyoti, Kufri Bahar, Kufri Pukhraj and Kufri Chipsona 1 together contributed around 75% of the total area of potato (Datta, 2020).

Significance of study: -

Potato diseases are commonly caused by fungi, bacteria and viruses.some common diseases are early blight of potato, late blight of potato, common scarp, pink rot leaf spot, leaf roll etc.

Early blight of potato caused by the *Alternaria Solani*, shows symptom as brown circular spot on leaves which can lead to premature leaf drop and tuber damage. It reduce the yield and quality of the potato.

1) Biocontrol agents – It is very much significant in managing early blight of potato, they are eco-friendly and alternative to chemical and hazardous fungicides. It promotes the overall crop health.
2) Plant extracts- Using the plant extract the early blight of potato control effectively, it is easily available, cost effective, eco-friendly and alternative to the chemicals. It inhibits the growth of *Alternaria Solani*. It promotes the entire growth and increase the yield of potato tuber.
3) Climatic conditions- It is useful to understand how climatic factors impact on the early blight of potato. The temperature range between 41 to 86-degreefaraday and high humidity promote the spore of potato tuber.
4) Fungicides- fungicides are prevent the development of the *Alternaria Solani*. It can prevent infection before it occurs and can also reduce the severity of existing infection.

Sr.no	Year	Activity	Tentative duration
01	Ist year	Literature survey & review of literature Survey, collection of *Early Alternaria blight* infected leaves of potato from Marathwada region. Study of disease severity. Isolation, Purification, Identification of *Alternaria solani* (EII. & Mart.) pathogen.	6 Months 6 Months
02	IInd year	Pathogenicity test. In Vitro & In Vivo growth. Effect of different fungicides. Effect of different climatic factor.	6months 6months
03	IIIrd year	Efficacy of different plant leaves extract carried out by food poisoning technique. Effect of different biocontrol agents. Data analysis writing for submission of synopsis & Thesis.	6months 6months

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